Field Validation of MVA Technology for Offshore CCS: Novel Ultra-High-Resolution 3D Marine Seismic Technology (P-Cable)

FE0028193

Dr. Tip Meckel
Gulf Coast Carbon Center
Bureau of Economic Geology
The University of Texas at Austin

U.S. Department of Energy
National Energy Technology Laboratory
Carbon Management Project Review Meeting
August 28-31, 2023

Program Overview

Funding: $3,123,320 DOE: $2,498,654 Cost Share: $624,666

Project Performance Dates
October 1, 2016 – September 30, 2024

NCE, original end date Sept. 30, 2019

Goal: Validate technologies to enhance MVA at active CCS site(s)

Objectives:

1) Acquire UHR3D marine seismic dataset and validate MVA technology at operational CCS field demonstration project - FOAK
2) Validate novel positioning techniques
3) Environmental Monitoring

Project Participants

U.S. DEPARTMENT OF ENERGY

NETL

Thank you to our Japanese colleagues!

Gulf Coast Carbon Center

METI
Ministry of Economy, Trade and Industry

Japan CCS Co., Ltd.

JGI, Inc.

TEXAS Geosciences
Bureau of Economic Geology
Jackson School of Geosciences
The University of Texas at Austin

MARINE ECOLOGY RESEARCH INSTITUTE

RITE Research Institute of Innovative Technology for the Earth

Project Overview

- **Ministry of Economy, Trade and Industry (METI)**
- **Japan CCS Co., Ltd. (JCCS)**
- **2012-2020**
- **Demonstrate and verify integrated CCS system**
  - **CO_2 gas separation, compression, transport, geologic storage**
- **100,000 tonnes/year rate, 3 year injection**
  - **CO_2 is captured from offgas generated at a hydrogen production unit in refinery**
  - **~70,000 tons by HR3D survey date in August 2017**
- **Moebetsu Formation saline aquifer @ 1100 m**
- **2 INJ; 3 OBS; Conventional 3D seismic, Seismology, Marine Geochemistry**
- **2 reports to METI; "Geological evaluation report of Tomakomai Area", and "Basic Plan of CCS demonstration project at Tomakomai Area"; Other resources in GHGT Proceedings.**

Technical Approach/Project Scope

Task 2.0: Ultra-High Resolution 3D Marine Seismic Imaging

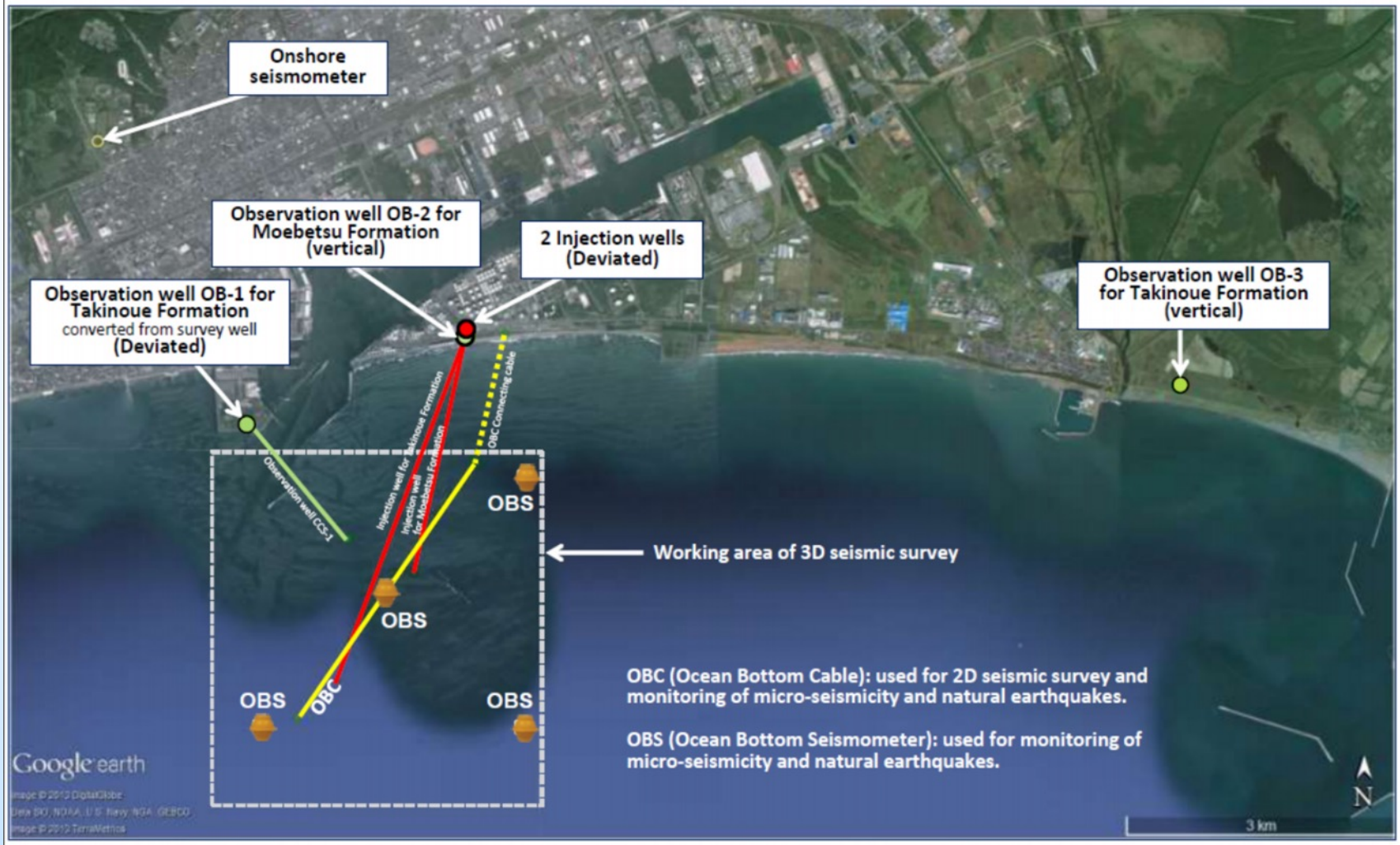
- **Subtask 2.1.1:** CO_2 Sensitivity Study
- **Subtask 2.1.2:** Vessel Subcontracting Preparation
- **Subtask 2.2:** P-Cable acquisition survey
- **Subtask 2.3:** P-Cable data processing
- **Subtask 2.3.1:** 4D Repeatability Study
- **Subtask 2.4:** P-Cable data interpretation

Task 3.0: Shallow Sediment Core Sampling and Geochemistry

- **Subtask 3.1:** Shallow sediment core sampling
- **Subtask 3.2:** Core geochemistry
- **Subtask 3.3:** Interpretation and integration

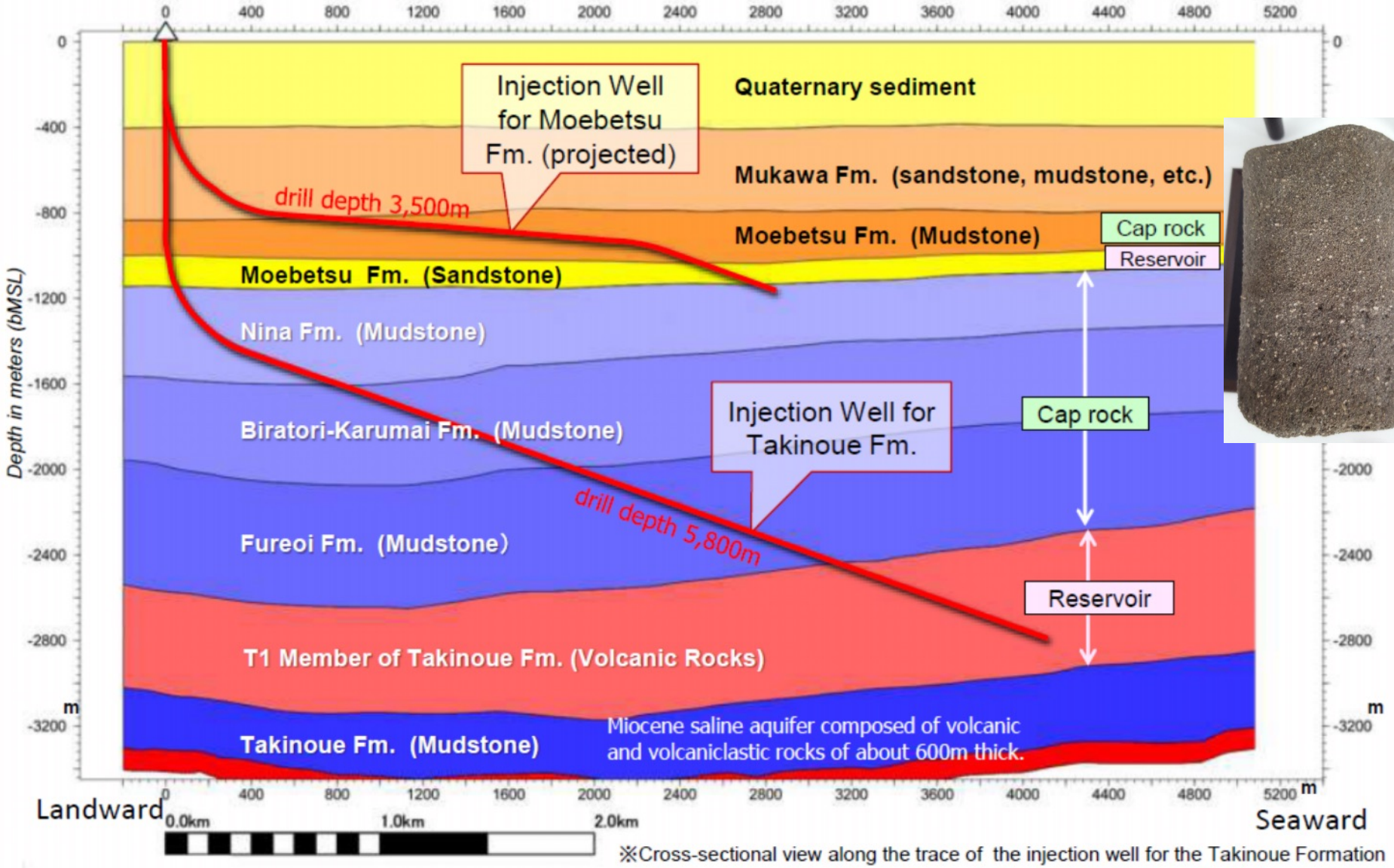
Tomakomai Port, Hokkaido Japan

Layout of Monitoring Facilities



JCCS

Schematic Geological Section

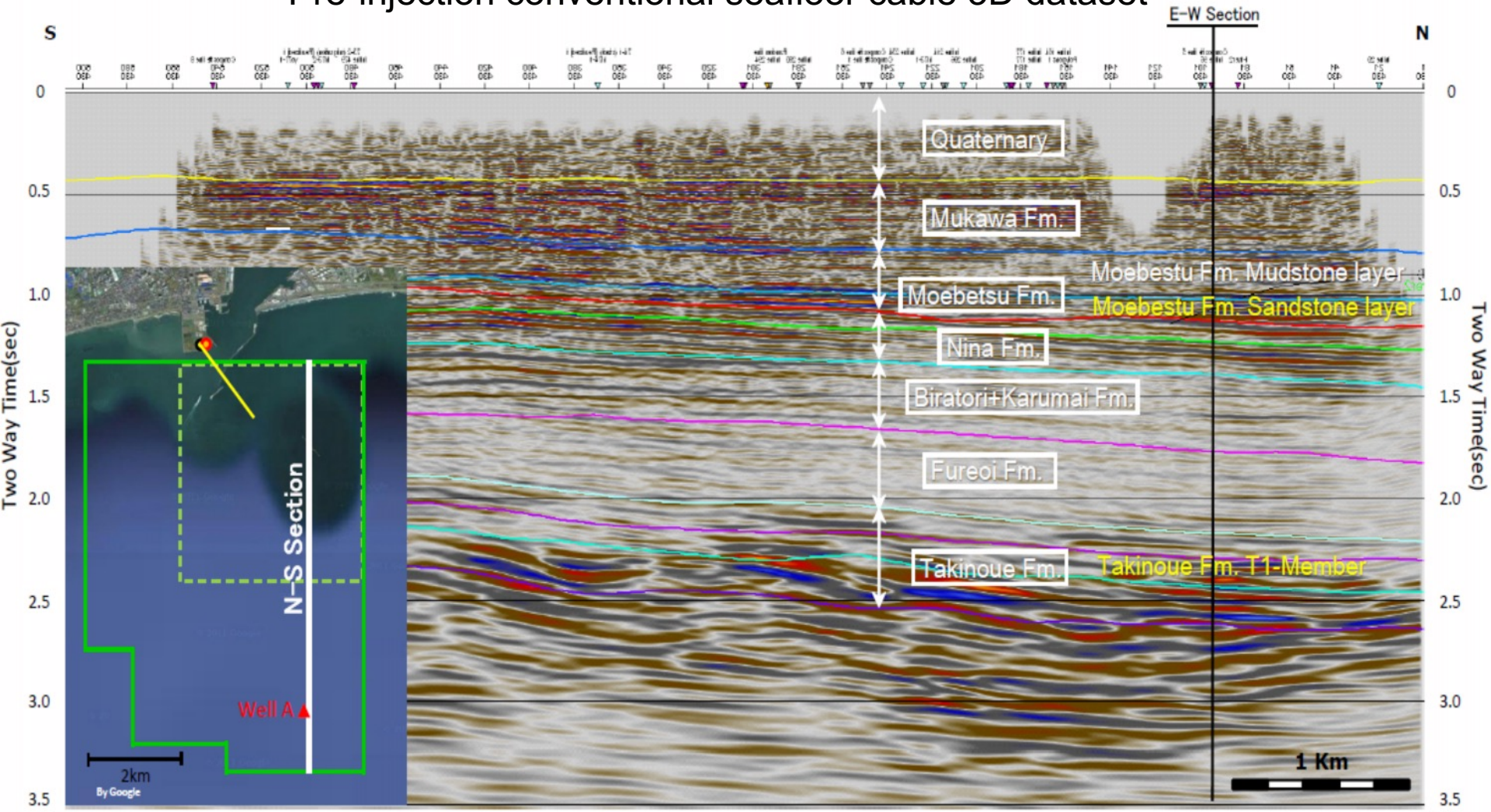


※Cross-sectional view along the trace of the injection well for the Takinoue Formation

JCCS

Geological Structure: North-South Section by 3 D Seismic Survey

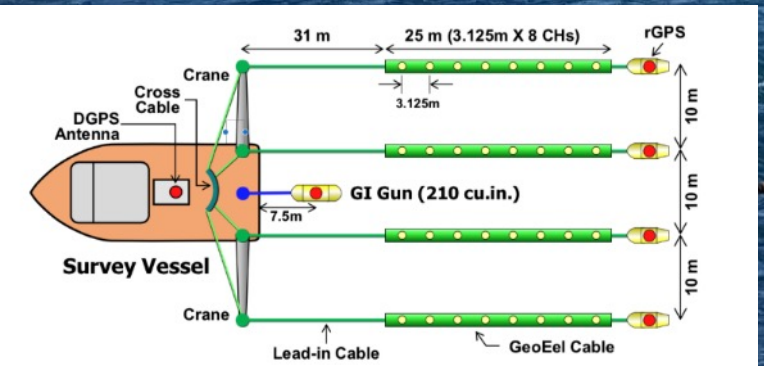
Pre-injection conventional seafloor cable 3D dataset



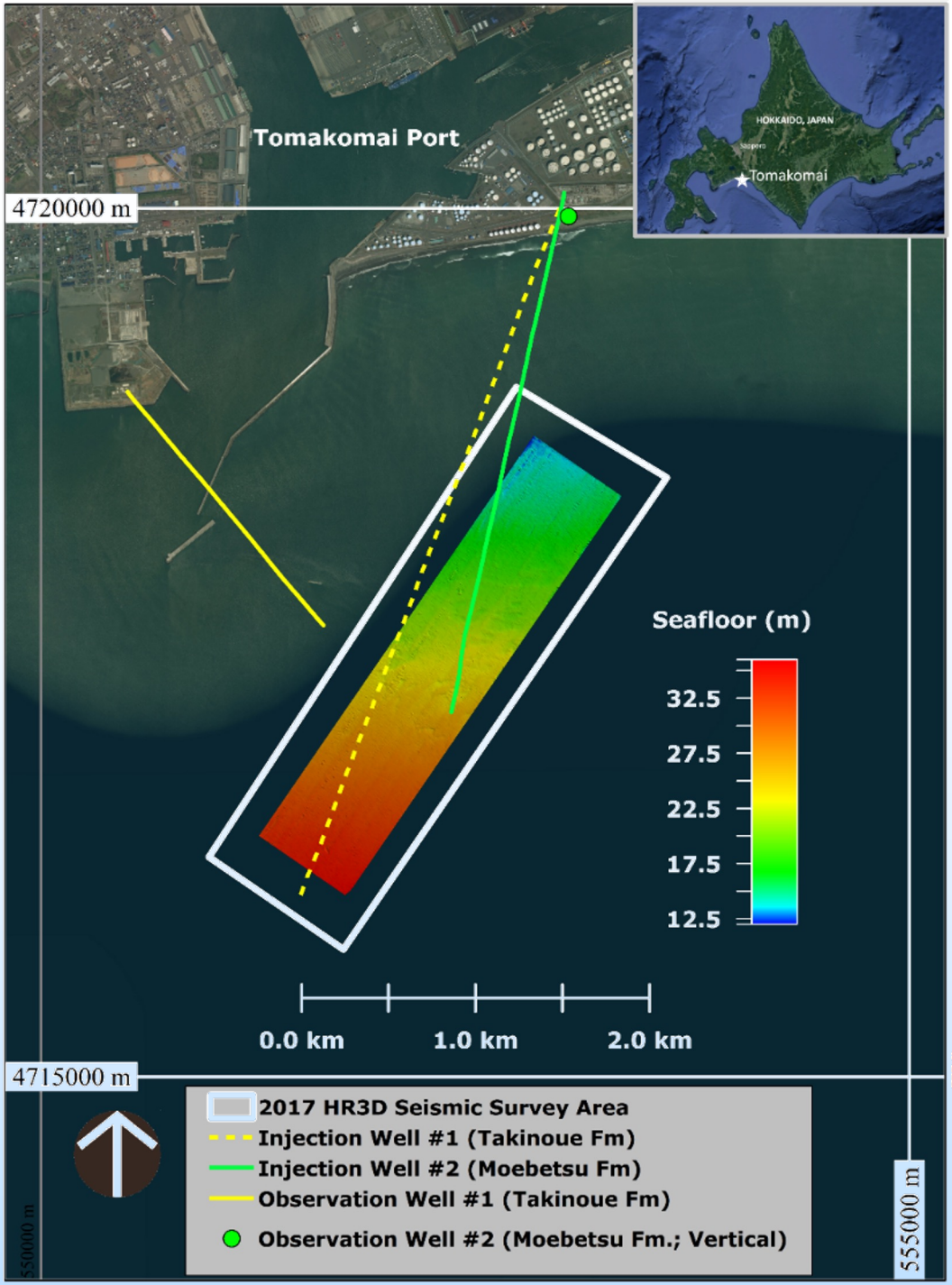
HR3D acquisition August 2017

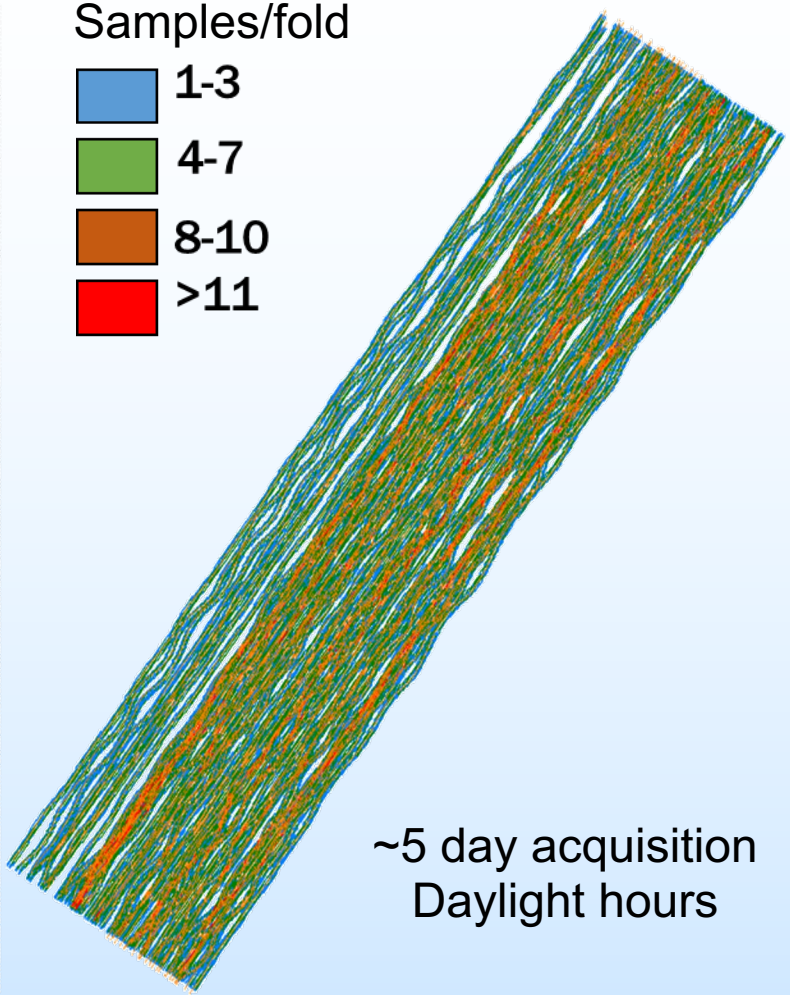
CO_2 Injection

Gas Separation



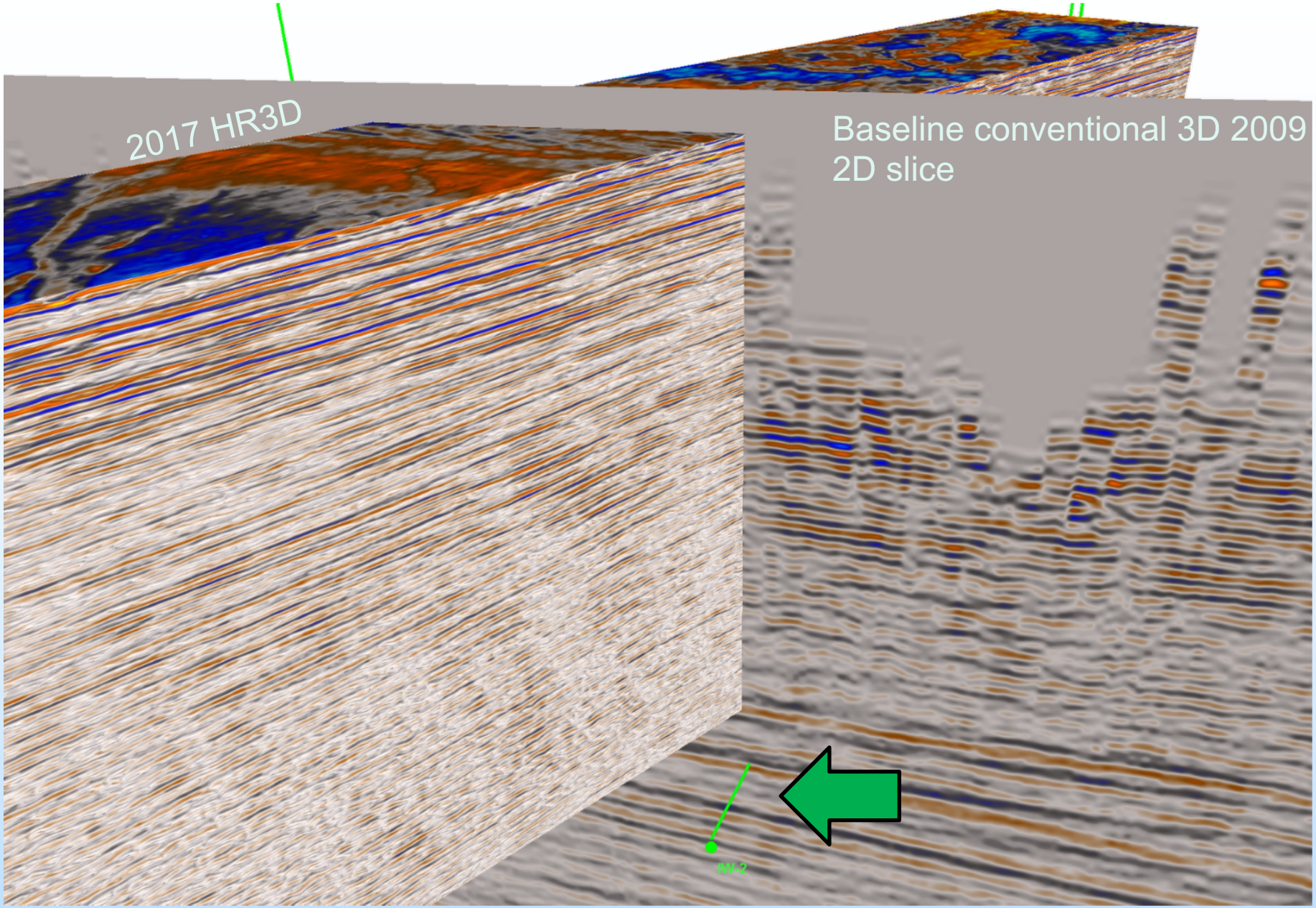
CDP Binning



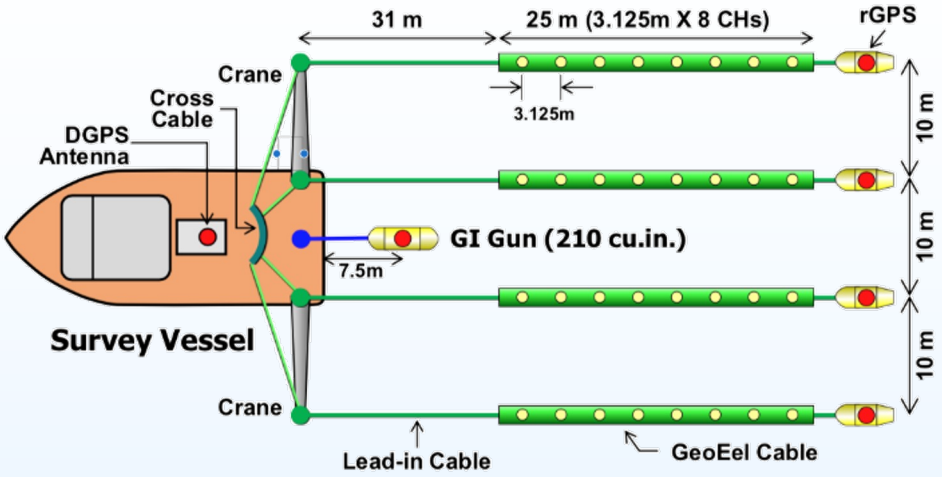


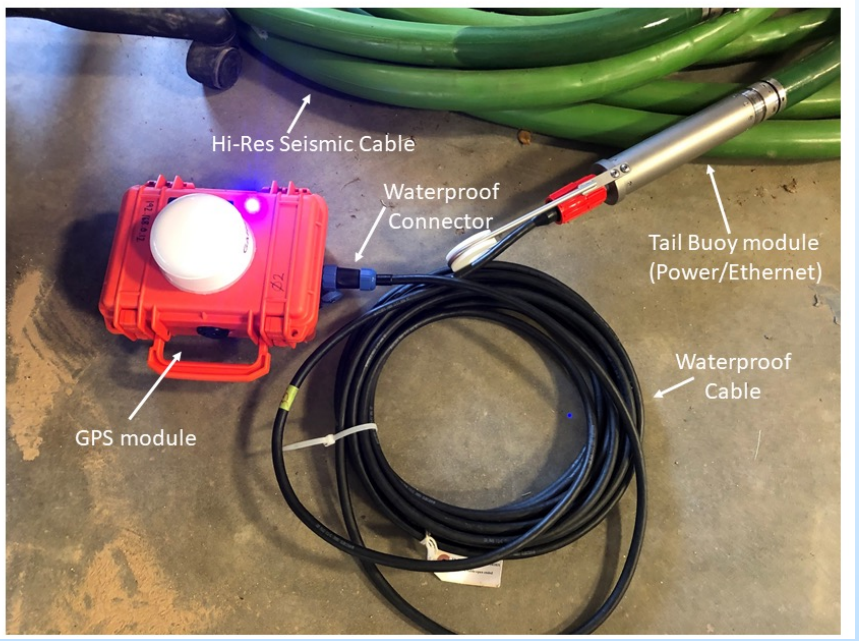
~5 day acquisition
Daylight hours

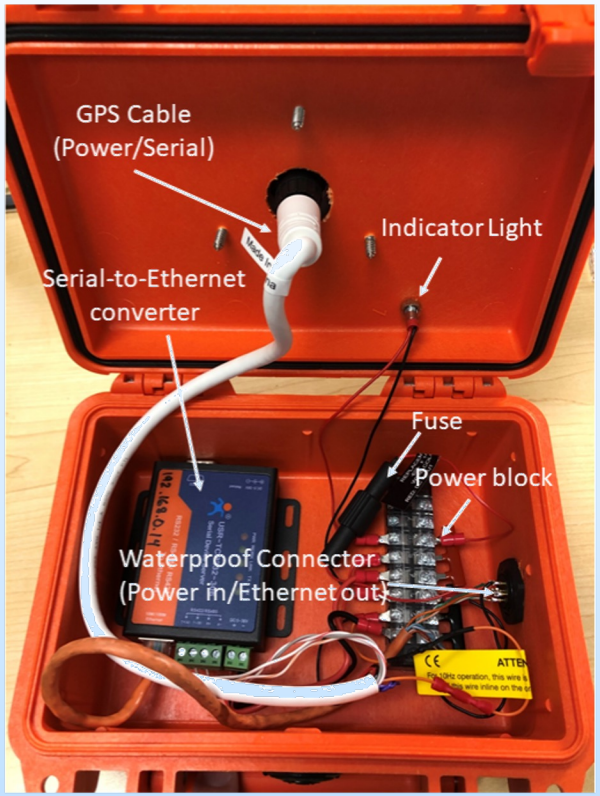
HR3D vs Conventional 3D



Recent significant accomplishments: Positioning







Current Status

- **NCE** through September 2024 approved.

- Active-source offshore seismic surveys in the Gulf of Mexico using Federal Funds cannot receive a **Categorical Exclusion** from further NEPA requirements.

- BEG hired **LGL, Ltd.** to assist with an **Environmental Assessment** (EA)
  - Communications between the NETL NEPA compliance officer, LGL and BEG about the National Marine Fisheries Service (NMFS) regarding an IHAA (incidental harassment authorization application)
  - LGL drafted and sent letters for publicizing the proposed HR3D survey. The letters were to be sent to libraries (e.g., Galveston Rosenberg library) and the Galveston, TX newspaper.
  - March 7, 2023 sent the IHAA to NOAA NMFS
  - The Texas General Land Office (GLO) determined that there were no significant unresolved federal/state consistency issues with respect to the pending EA.
  - The proposed IHA published in the Federal Register 8/7/23. The public comment period will end on 9/7.

Plans for future testing/development/ commercialization

- This project intends to conduct a HR3D seismic survey at San Luis Pass offshore Galveston Island using newly developed tail buoy GPS pending results of an Environmental Assessment.

- After this project: Learnings related to source-receiver positioning and the Environmental Assessment Permitting will be applicable to the next projects undertaken with this technology.
  - GoMCARB Partnership surveys previously funded

- Scale-up potential: It is anticipated that high-resolution geophysical surveys will become an instrumental and routine aspect of future commercial CCS projects for both pre-injection characterization as well as monitoring.

SUMMARY

1. **Successful demonstration of HR3D as a tool for CCS characterization and monitoring in overburden.**
2. A successful **first high-resolution 3D survey at an active offshore CO_2 injection site** was collected Aug. 2017.
   - Imaging depth ~600 ms twtt = source energy; very noisy port environment.
   - Lack of any apparent faults or fluid/gas anomalies in overburden.
3. **Repeatability Study** – results look promising for 4D in shallow interval.
   - A second survey cannot be hosted at Tomakomai.
4. Successful development and testing of new **tail buoy GPS** with power and data via streamers.
5. **Second HR3D survey** at San Luis Pass pending Environmental Assessment & FONSI.

Gulf Coast Carbon Center

THANK YOU – QUESTIONS?

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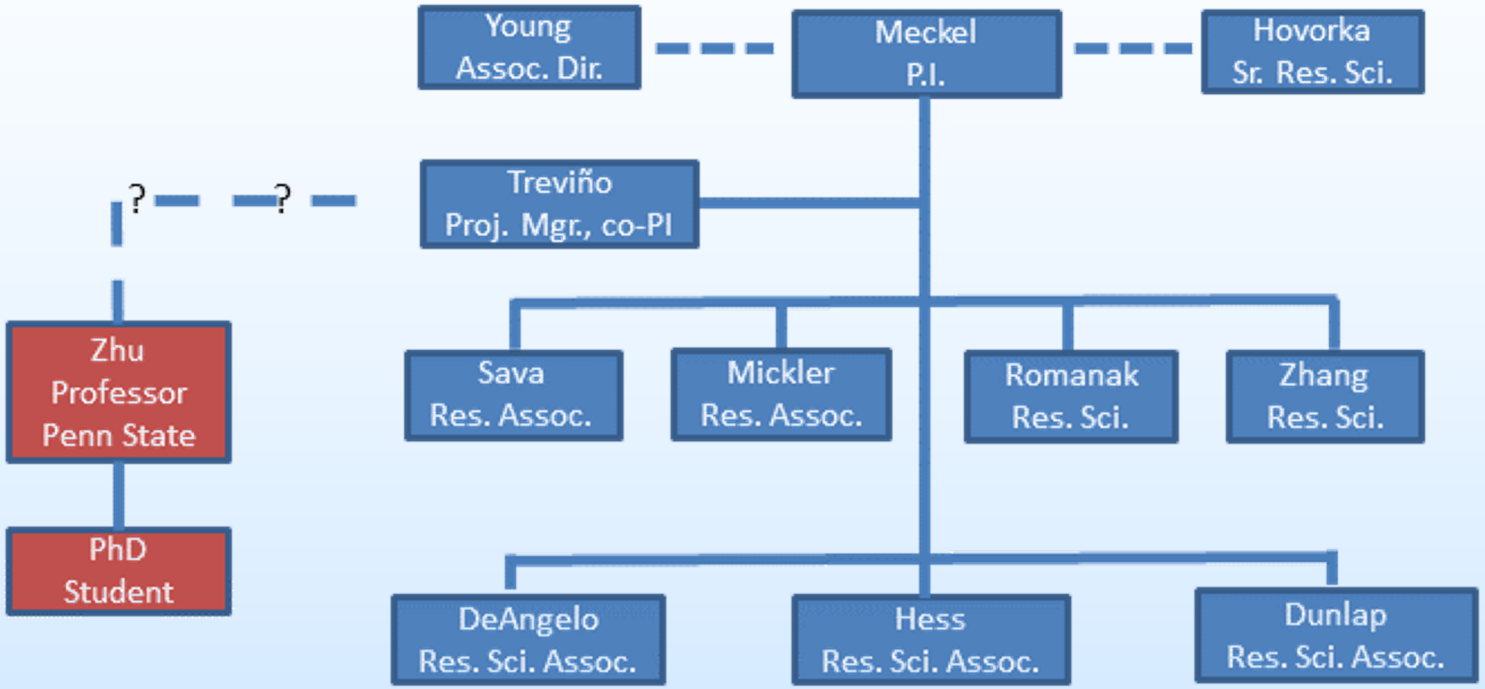
Appendix

– These slides will not be discussed during the presentation but are mandatory.

Organization Chart



Gantt Chart

		BUDGET PERIOD 1				BUDGET PERIOD 2				BUDGET PERIOD 3							
		YEAR 1				YEAR 2				YEAR 3				YEAR 4			
Task	Tasks	qtr 1	qtr2	qtr3	qtr4	qtr 1	qtr2	qtr3	qtr4	qtr 1	qtr2	qtr3	qtr4	qtr 1	qtr2	qtr3	qtr4
Field Validation of MVA Technology for Offshore CCS: Novel Ultra-High-Resolution 3D Marine Seismic Technology (P-Cable)																	
1) PROJECT MANAGEMENT, PLANNING, and REPORTING																	
1.1	PMP, TMP, DMP	D1 D2 D3															
1.2	Meetings																
1.3	Reporting	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q F
1,4	Project Management																
2) UHR3D SEISMIC IMAGING																	
2.1	CO2 SENSITIVITY STUDY			D4 M1 DP1													
2.2	P-Cable ACQUISITION				M2 M3									M5	M6		
2.3	P-Cable PROCESSING					D5	M4 D6 DP2										M8 D9
2.4	P-Cable INTERPRETATION									D7							M10
3) SHALLOW SEDIMENT CORE SAMPLING AND GEOCHEMISTRY																	
3.1	Shallow Sediment Core Sampling									M7							
3.2	Core Geochemistry										M9						
3.3	Interpretation & Integration											D8					

Q = Quarterly Report; A = Annual Report; F = Final Report
M = Milestone; DP = Decision Point; D = Deliverable;

Benefit to the Program

Program goal being addressed:

- This study supports SubTER pillar 4 (new subsurface signals) and advances the long-term Carbon Storage program goal of developing technologies to ensure 99 percent storage permanence.

Benefits statement:

- The project will conduct research under Area of Interest 1, Field Demonstration of MVA Technologies, by deploying and validating novel ultra-high resolution 3D seismic technology for CCS MVA at an active operational field site. This research will advance the MVA technology development pathway to TRL 7 by validating a fully integrated prototype seismic imaging system including untested dynamic acoustic positioning. The technology will demonstrate significantly improved spatial resolution over a commercially-meaningful area with improved accuracy and economic viability, decreasing the cost and uncertainty in measurements needed to satisfy regulations for tracking the subsurface fate of CO_2.

Bibliography

– List peer reviewed publications generated from the project per the format of the examples below.

- Meckel, T.A., Y. Feng, R.H. Trevino, and D. Sava, 2019, *High-resolution 3D marine seismic acquisition in the overburden at the Tomakomai CO2 storage project, offshore Hokkaido, Japan*, IJGGC, 88:124-133. https://doi.org/10.1016/j.ijggc.2019.05.034